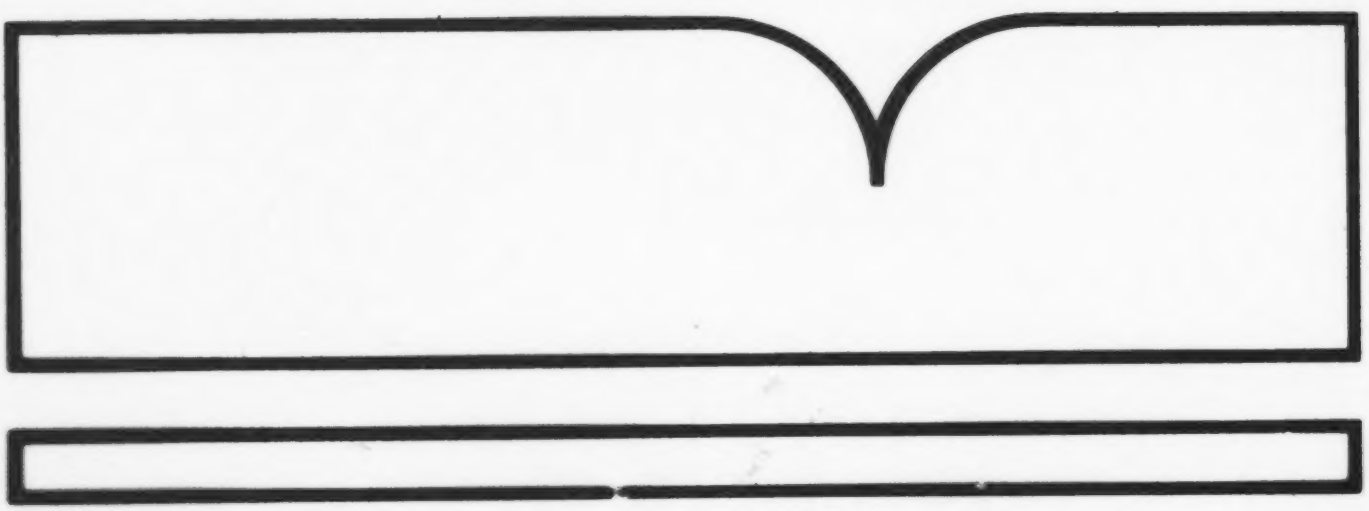
PB90-103755

SITE (Superfund Innovative Technology Evaluation) Program Update: An Introduction

(U.S.) Environmental Protection Agency, Cincinnati, OH

Jan 89



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TECHNICAL REPORT DATA
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1. REPORT NO.	2.	3. PB90-103755
EPA/600/J-89/070		

4. TITLE AND SUBTITLE
SITE Program Update: An Introduction; Overview of the Superfund Innovative Technology Evaluation (SITE) Program

5. REPORT DATE

6. PERFORMING ORGANIZATION CODE

7. AUTHOR(S)
Robert A. Olexsey

8. PERFORMING ORGANIZATION REPORT NO

9. PERFORMING ORGANIZATION NAME AND ADDRESS
SITE Demonstration and Evaluation Branch
Superfund Technology Demonstration Division, RREL
Cincinnati, Ohio

10. PROGRAM ELEMENT NO.

11. CONTRACT/GRANT NO

12. SPONSORING AGENCY NAME AND ADDRESS
Risk Reduction Engineering Laboratory--Cincinnati, OH
Office of Research and Development
U.S. Environmental Protection Agency
Cincinnati, OH

13. TYPE OF REPORT AND PERIOD COVERED

14. SPONSORING AGENCY CODE
EPA/600/14

15. SUPPLEMENTARY NOTES
Robert A. Olexsey, 684-7696 - 513/684-7696
For JAPCA Journal Article, Pittsburgh, PA, published in the January issue.

16. ABSTRACT

In 1986, the U.S. Environmental Protection Agency's Offices of Solid Waste and Emergency Response (OSWER), and the Office of Research and Development (ORD) established a technology research, demonstration, and evaluation program to promote the development and use of alternative and innovative technologies at Superfund sites. The program established is the Superfund Innovative Technology Evaluation, or SITE program; this program will help provide the treatment technologies necessary to implement new cleanup standards that require a greater reliance on permanent remedies at Superfund sites. The Risk Reduction Engineering Laboratory, conducts the SITE Program in three areas: (1) a field-scale demonstration program; (2) an emerging technologies development program; and (3) innovative technologies development within the EPA.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field Group

18. DISTRIBUTION STATEMENT	19. SECURITY CLASS (This Report)	21. NO OF PAGES
Release to Public	Unclassified	9
	20. SECURITY CLASS (This page)	22. PRICE
	Unclassified	

EPA Form 2220-1 (Rev. 4-77) PREVIOUS EDITION IS OBSOLETE

EPA/600/J-89/070

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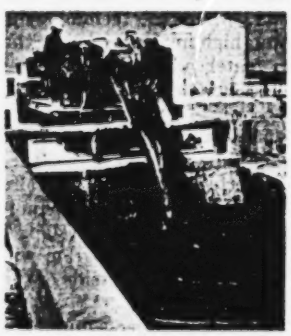
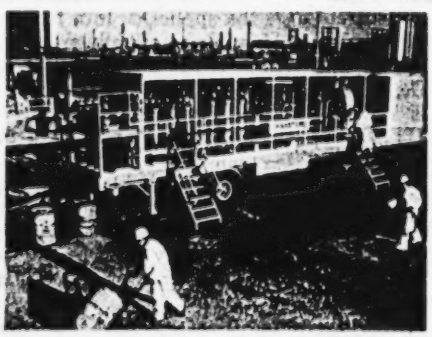
The following article presents an overview of the SITE program. It is the first of several articles on the program that will be presented in 1989 in JAPCA. Subsequent articles will discuss selected specific projects or unique aspects of the SITE program. The authors of the articles will be the EPA Project Managers who are responsible for the project or the program area that is discussed.

Readers who are interested in obtaining additional information on the SITE Program or on a specific project should contact the authors or the individuals listed as EPA contacts in the article.

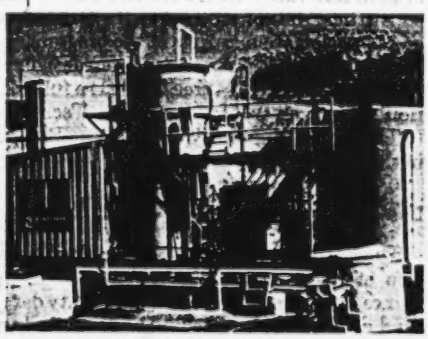
Shown on the cover and below are three of the 28 technologies which are currently active participants in the SITE program.



Solidtech unit dumping waste slurry, flyash, and a special additive into a drying bed.



CF Systems mobile unit (1 gpm) operating on pit lagoon sludges in Texas.



Zimpro mobile PACT (Powered Activated Carbon Treatment) Unit proposed for demonstration at approximately 10,000 gal/per day.

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SITE PROGRAM UPDATE: PART I

Overview of the Superfund Innovative Technology Evaluation (SITE) Program

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Superfund Technology Demonstration Division
Risk Reduction Engineering Laboratory
Cincinnati, Ohio

Provided below are detailed descriptions of the three main components of the SITE Program: the Demonstration Program; the Emerging Technologies Program; and the Innovative Technologies Program. Tables describe the various technologies that have been developed in these programs, and tell how to contact the developer and/or EPA for more information.

The 1986 amendments to Superfund[1] create a comprehensive program of research, development, demonstration, and training to promote the development and demonstration of alternative and innovative treatment technologies. The terms "alternative or innovative treatment technologies" are defined in the law to mean those technologies that permanently alter the composition of hazardous wastes through chemical, biological, or physical means so as to significantly reduce the toxicity, mobility, or volume. The terms also include technologies that characterize the extent and nature of site contamination and technologies that assess the stresses imposed by contaminants.

In order to carry out this legislative mandate, the EPA has established the SITE program. A strategy and program plan has been developed and published.[2] In addition, the progress and accomplishments of the program were reported to the United States Congress in February 1988.[3]

The overall goal of the SITE program is to maximize the use of alternatives to land disposal in cleaning up Superfund sites and to encourage the development and demonstration of new, innovative treatment and monitoring technologies. This article will concentrate on the technology development and demonstration aspects of the program.

The technology program has been designed to accomplish the above goals along three lines: (1) a full-scale Demonstration Program; (2) an Emerging Technologies Program (ETP); and (3) Innovative Technology Program (ITP) within the EPA.

Demonstration Program

The purpose of the demonstration program is the evaluation of selected technologies in order to develop performance, cost-effectiveness, and reliability data so that Superfund decision-makers can make sound judgments as to the applicability of the technology to a particular site. The results of the demonstration will identify the performance of the technology on a specific site, the wastes and media to which it can be applied, the operating procedures, and the approximate capital and operating costs. The demonstrations will be carried out at field-scale or at a scale that allows valid comparison and direct scale-up to commercial size units. The duration of the demonstration will be determined on a case-by-case basis but must be of a sufficient time to adequately characterize equipment reliability and operational variabilities.

Usually, SITE demonstrations will be conducted at actual uncontrolled hazardous waste sites including Superfund sites, state sites, sites including other federal agencies, and private party sites. Demonstrations may be conducted at EPA-operated test and evaluation (T&E) facilities. These T&E facilities would have adequate pollution control and safety equipment in place so that technologies could be evaluated over a wide range of operation without pollutant releases outside of the facility. The T&E facilities could provide for faster testing of smaller and moderate size units under safe and controlled conditions at a lower cost. The tests conducted at these facilities would be on wastes brought in from an actual hazardous waste site.

The funding of the demonstration will be cost-shared between the EPA and the applicant. The technology developer will pay the costs to mobilize and operate the equipment onsite, and dismantle and remove the equipment at the end of the demonstration. The EPA will pay for the costs of sampling and analysis, quality assurance and quality control, evaluating data, and preparing reports. The EPA may also help the developer obtain any required permits. Normally, there will be no exchange of funds between the Agency and the applicant. In a few instances where the technology is unique, unusually promising, and high in financial risk, the EPA will consider bearing a greater portion of the total project cost if the developer is unable to obtain financing elsewhere.

At the completion of the demonstration, the EPA will undertake activities to encourage wide-scale use of the successful technologies for the Superfund cleanup program. The Agency will evaluate the application of these technologies to other sites and to wastes other than those tested. A technology transfer and technical assistance program will transmit results to potential users within and outside of the Agency.

The EPA has issued three requests for projects under the demonstration program—one in 1986, the second in January 1987, and the third in January 1988. Another request for projects will be issued in January 1989.

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Table II. SITE emerging technologies demonstrations.

Developer	Technology	Descriptions	Developer contact	EPA contact
Atomic Energy of Canada, Ltd. Ontario, Canada	Toxic metals removal	The use of ultrafiltration in combination with water soluble macromolecular compounds to selectively remove heavy metal ions from aqueous waste solutions.	L. P. Buckley 613-584-3311	John Martin 513-569-7758
Battelle Memorial Institute, Columbus, OH	Electroacoustic soil decontamination	The in situ treatment of soils contaminated with fuel oil, hazardous organic compounds, and heavy metals by the application of electric and acoustic fields. The electroacoustic process will be used to remove the contaminants from the capillaries.	H. S. Muralidhara 614-424-6424	Jonathan Herrmann 513-569-7839
Bio-Recovery Systems, Inc. Las Cruces, NM	Sorption of heavy metals by alga SORB	Immobilized algae cells in a silicon gel polymer are used to form ion-exchange-like resins to remove heavy metal ions from aqueous solutions.	Dennis Darnall 505-646-5888	Naomi Barkley 513-569-7854
Colorado School of Mines Golden, CO	Wetlands treatment to remove heavy metals	A wetland-based treatment technology is based on the concept of using national geochemical and biological processes inherent in a wetland ecosystem to remove and accumulate metals from influent waters. A man-made wetlands will be evaluated.	Thomas Wildeman 303-273-3642	Edward Bates 513-569-7774
Energy & Environmental Engineering, Inc. Somerville, MA	Laser stimulated photochemical oxidation	Suspended solids are removed from groundwater and washed. The wash water and groundwater are then treated in a photochemical reactor utilizing a laser beam.	James Porter 617-666-5500	Ronald Lewis 513-569-7862
Envirite Field Services, Inc. Atlanta, GA	Solvent soil washing	Soil is washed utilizing a potential blend of solvents. The solvent is removed from the soil by steam stripping.	Thomas McGowan 404-876-8300	S. Jackson Hubbard 513-569-7507
Western Research Institute, Laramie, WY	In situ oil recovery and biodegradation	Oil and waste are recovered from the soil by controlled injection of steam, and hot and cold water. Residual organic pollutants in the soil are biodegraded.	Wesley Barnes 307-721-2011	Edward Bates 513-569-7774

As of November 1988, 28 technologies are active participants in the program. These are summarized in Table I. Seven demonstrations have been completed at superfund sites. The Shirco Infrared System was demonstrated at the Peak Oil site in Brandon, Florida, and the Rose Township site in Michigan. Two solidification/stabilization processes have been demonstrated; first, the Hazcon process at Douglassville, Pennsylvania and second, International Waste Technologies at Hialeah, Florida.

Terra Vac's insitu vacuum extraction process was demonstrated in Groveland, Massachusetts. To demonstrate the American Combustion burner, waste from the Stringfellow site in California was brought to the EPA's Combustion Research Facility in Jefferson, Arkansas. The CF Systems Corporation solvent extraction process was demonstrated on sediments at New Bedford Harbor in Massachusetts.

Table I also provides a listing of developer participants and EPA contacts for the SITE Demonstration Program.

Emerging Technologies Program

The purpose of the Emerging Technologies Program is to foster the further development of technologies that are not yet ready for field-scale demonstration. The goal is to ensure that a steady stream of more permanent, cost-effective technologies will be established to be considered for demonstration in the field, thereby increasing the number of viable alternatives available for use, in Superfund cleanups. The ETP will deal with innovative technologies for recycling, separation, detoxification, destruction, and stabilization of hazardous chemical wastes. These emerging technologies will include, but not be limited to, chemical, biological, thermal, physical, and stabilization/solidification treatment processes.

The ETP will provide a 2-year cost-share funding to technology developers that take promising bench/laboratory-scale technologies to the field-scale. The ETP will pay up to $150,000 per year, for a maximum of $300,000 over 2 years, available to individuals with acceptable technologies. In order to obtain second year funding, significant progress must be made during the first year. The first solicitation for ETP occurred in September 1987. Of the 84 proposals that were submitted, seven were selected for cost-share funding. The second solicitation occurred in July 1988.

The seven technologies selected from the first solicitation are summarized in Table II. These projects started in August/September 1988.

Innovative Technologies Program

The Risk Reduction Engineering Laboratory has developed an in-house R&D program resulting in technologies that have application to solving problems found at Superfund sites. The goal of the ITP is to facilitate and accelerate the development of those technologies from the pilot-scale to field-scale demonstration. After the EPA has carried the technologies through concept, development, and field demonstration, commercial firms will be sought to enter an agreements with the EPA to field demonstrate and commercialize the technology. In return for this commitment from the commercial sector, the EPA will grant a user's agreement with the firm allowing it to utilize the technology. The au-

Table I. SITE demonstration technologies descriptions (continued).

Developer	Technology	Descriptions	Developer contact	EPA contact
				Paul de Bruin ~~Mary Stinson~~
Toxic Treatments, Inc. San Mateo, CA	In situ steam/air stripping	Steam and air are injected into the soil through a series of drill holes to strip volatile contaminants. To be demonstrated in 1989.	A. P. Statham 415-572-2994	201-321-6683
Westinghouse Electric Corporation, Madison, PA	Pyroplasma system	The pyroplasma process pyrolyzes wastes using a thermal plasma field. The heart of the system is a plasma arc torch which produces a thermal plasma with temperatures of more than 9,000°F. Waste liquids are injected directly into the plasma where the molecules are broken into their atomic states and the atoms then recombine to produce hydrogen, carbon monoxide, nitrogen, hydrogen chloride particulate carbon, carbon dioxide, ethylene, and acethylene. The product gas is scrubbed with caustic soda to neutralize and remove the acid gases and remove particulates. To be demonstrated in 1989.	John Gross 412-722-5655	Eugene Harris 513-569-7862
		Chemical treatment		
CF Systems Corporation Cambridge, MA	Solvent extraction	Solvent extraction using liquified gases near their critical conditions as solvents to remove organic pollutants from sludges, solids, or liquid waste. Demonstration completed.	John M. Moses 617-492-1631	Richard Valentinetti 202-382-5753
Resources Conservation Company Bellevue, WA	Solvent extraction	The BEST™ extraction sludge treatment process was developed to de-water and de-oil contaminated sludges and soils, including those containing PCB's. A chemical plant-like process uses differences in chemical miscibility at different temperatures to break waste down into three distinct fractions: (1) dischargeable water, (2) reusable oil and organics, and (3) dry, oil-free solids. To be demonstrated in 1989.	Paul McGough 206-828-2400	Edward Bates 513-569-7774
Ultrox International Santa Ana, CA	Ultraviolet radiation and ozone	Treatment of organics in groundwater and leachate by ultraviolet radiation and ozone. To be demonstrated in 1989.	David B. Fletcher 714-545-5557	Norma Lewis 513-569-7665
		Biological treatment		
Biotrol, Inc. Chaska, MN	Fixed-film plug flow bioreactor	Uses amended microbial consortium to treat organics in groundwater and leachates in a fixed-film plug flow reactor. To be demonstrated in 1989.	Thomas Chresand 612-448-2515	Mary Stinson 201-321-6683
DETOX Industries, Inc. Sugarland, TX	Biological degradation	Proprietary nationally-occurring organisms are utilized in a reactor in a batch process to degrade organic contaminants. To be demonstrated in 1988.	Thomas Dardas 714-240-0892	Ronald Lewis 513-569-7856
DETOX, Inc. Dayton, OH	Fixed-film bioreactor	Biological treatment of liquids with low organic concentrations. The fixed-film bioreactor should result in short retention times. To be demonstrated in 1989.	George Skladany 513-433-7394	Ronald Lewis 513-569-7856
MoTec, Inc. Mt. Juliet, TN	Liquid/solid contact digestion	Portable high energy mixer for biodegradation of organic waste in soils and sludges. To be demonstrated in 1989.	John Bogart 615-754-9626	Eugene Harris 513-569-7862
Zimpro Environmental Control Systems Rothschild, WI	Powdered activated carbon/biological	Combination of biological treatment, powdered activated carbon-treatment, and wet air oxidation for treatment of concentrated aqueous waste. To be demonstrated in 1989.	William Copa 715-359-7211	John Martin 513-569-7758
		Physical treatment		
Biotrol, Inc. Chaska, MN	Soil washing	Physical size separation and water washing process for treating contaminated soils. To be demonstrated in 1989.	Steve Valine 612-448-2515	Mary Stinson 201-321-6683
CBI Freeze Technologies, Inc. Plainfield, IL	Volume reduction by freezing	Physical separation and concentration of contaminants from water using a freezing system mounted in a trailer. To be demonstrated in 1989.	Matt Husain 815-436-2912	S. Jackson Hubbard 513-569-7507

Table I. SITE demonstration technologies descriptions (continued).

Developer	Technology	Descriptions	Developer contact	EPA contact
E. I. Dupont de Nemours Newark, DE	Microfiltration	Treatment of liquid waste having 10 ppm to 30 percent solids with high-density polyethylene filter media. To be demonstrated in 1989.	Ernest Mayer 302-366-3652	John Martin 513-569-7758
Sanitech, Inc. Twinsburg, OH	Ion exchange	Use of ion-exchange-like materials to selectively remove heavy metals from water. To be demonstrated in 1989.	Sidney Nelson 216-425-2354	Richard Traver 201-321-6677
Terra Vac, Inc. San Juan, PR	In-situ vacuum extraction	Volatile contaminants are vacuum extracted from the soil through wells and removed from the air stream by carbon. Demonstration is completed.	James Malot 809-723-9171	Mary Stinson 201-321-6683
Freeze Technologies Corp. Raleigh, NC	Freeze crystallization	Mixed waste liquid enters through a feed heat exchanger where it is cooled to within a few degrees of its freezing temperature. The cooled feed than enters a crystallization where it is mixed with boiling refrigerant. Water is crystallized in the stirred solution for subsequent removal and washing. The product ice is melted in an exit heat exchanger to provide cooling for the refrigerant. To be demonstrated in 1989.	James Heist 919-850-0600	Jonathan Herrmann 513-569-7839
		Solidification/stabilization		
Geosafe Corporation Richland, WA	In-situ vitrification	Electrodes inserted into the ground heat the surrounding soil to 2,000°C which melts the soil. A hood collects the off-gases which are treated. A chemically inert, crystalline product is produced from the soil. To be demonstrated in 1989.	James Hansen 206-822-4000	Jonathan Herrmann 513-569-7839
Chemfix Technologies, Inc. Metairie, LA	Chemical fixation/ stabilization	Proprietary process that stabilizes high molecular-weight organic and inorganic constituents in a waste slurry using soluable silicates, silicate setting agents, and additives to crosslink with waste components to produce a stable, solid matrix. To be demonstrated in 1989.	C. Paul Lo 504-831-3600	Edwin Barth 513-569-7669
Hazcon, Inc. Katy, TX	Solidification/stabilization	Process blends contaminated soil or sludge with cement, pozzolana, and a proprietary ingredient called Chloranan which aids in the solidification of organics. System is truck-mounted. Demonstration is completed.	Ray Funderbunk 713-934-4500	Paul de Percin 513-569-7797
International Waste Technologies Wichita, KS	In-situ stabilization	Deep soil mixing equipment is used to drill and blend a proprietary solidification/stabilization ingredient in situ. Drill is 0.9m in diameter and injects the slurry additive from the bottom of the shaft. Demonstration is completed.	Jeff Newton 316-269-2660	Mary Stinson 201-321-6683
Separation and Recovery Systems Irvine, CA	Lime-based technology	Lime and other minor chemicals are specially prepared to improve their reactivity to fix sludges with high concentrations (up to 3 percent) of hydrocarbons. Metals are also immobilized. To be demonstrated in 1989.	Joseph de Franco 714-216-8860	Richard Valentinetti 202-382-5753
Silicate Technology Corporation Scottsdale, AZ	Silicate treatment	Contaminated material is separated by size. The coarse material is shredded and sized and mixed with fines for the solidification process. Proprietary reagent is added in a batch plant and conveyed to a mixing truck. To be demonstrated in 1989.	Steve Pegler 602-948-1300	Edward Bates 513-569-7774
Soliditech, Inc. Houston, TX	Solidification	Proprietary reagent is added to the slurried hazardous material in a batch process. Reagent is microblended with the waste and microencapsulates the hazardous compounds by crosslinking organic and inorganic particles, coating larger particles, and sealing small pores and spaces. Demonstration conducted in December, 1988.	David Stang 713-778-1800	Walter Grube 513-569-7798

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Table III. SITE Innovative Technologies Program.

Technology	Descriptions
Mobile soil washer	A mobile soil washer has been developed. Soil washing separates contaminants from soil by high energy mixing of soils and solvents, additives, surfactants, acids, and bases. The soil washer consists of three components: a drum washer, a countercurrent extraction chamber, and a dewatering unit. Turbine mixers and air agitators keep the solution well mixed and efficiently strips out highly volatile organics. A vapor collection system removes volatile organics to carbon treatment units. The drum washer has a maximum throughput capacity of 18 cubic yards per hour, and the countercurrent trailer is limited to two cubic yards per hour.
KPEG treatment	Potassium polyethylene glycolate reagents are effective dehalogenators of aromatic and aliphatic organic materials, including PCB's and other toxic halides. The KPEG reagent reacts with the chlorine atoms in the aryl ring of halogenated aromatic contaminants to produce innocuous ether and potassium chloride salt. In some KPEG reagent formulations, dimethylsulfoxide is added as a cosolvent to enhance reaction rate kinetics. KPEG reagents are stable in air, tolerate moisture, are easily stored, and can be safely transported to problem sites unlike conventional anaerobic dehalogenating reagents. A large portable KPEG reactor (400 gallons) has been demonstrated on PCB-contaminated soils and a smaller pilot unit on oily pesticide wastes and liquid wood-preserving wastes.
In situ containment/treatment system	A mobile in situ containment/treatment system has been developed. The system is mounted on a 43-foot drop deck trailer and includes a diesel electric generator, an air compressor, mixing tanks, hoses, a solids feed conveyor, pipe injectors, soil testing apparatus, and accessory items. In situ containment and treatment is accomplished by direct injection of grouting material into the soil around the contaminated area in order to isolate the spill. The hazardous materials are then treated in place by oxidation/reduction, neutralization, or precipitation. When necessary, contaminated water can be withdrawn from wet wells and treated by other means.
Spent activated carbon regenerator	In order to provide a safe and effective method for handling contaminated carbon, a mobile unit for detoxifying/regenerating contaminated carbon at the cleanup site has been developed. The mobile detoxification/regeneration system, mounted on a 45-foot long semitrailer, is equipped with a rotary kiln, a second stage combustion chamber, and a gas scrubber. The unit is self-contained except for fuel and water supplies.
Electrokinetic removal of contaminants from the ground	The use of an electrokinetic process, in conjunction with pumping, to expedite ion migration and removal from a saturated soil system. A series of wells is used as anodes and cathodes across which a direct current is applied. The current density results in an accelerated movement of charged ions. The effect of ion migration is greater with pulse pumping.

thority for the federal government to enter into such an agreement is authorized by the Stevenson-Wydler Technology Transfer Act. Some of the technologies in the ITP are listed in Table III.

For further information about the technologies in the Innovative Technologies Program, contact the authors at 513-569-7696 or Mr. Jack Farlow at 201-321-6635.

References

1. *Superfund Amendments and Reauthorization Act of 1986*, U.S. Congress.
2. *Superfund Innovative Technology Evaluation (SITE) Strategy and Program Plan*, Report No. 540/G-86/001, U.S. EPA, Washington, DC, December 1986.
3. *The Superfund Innovative Technology Evaluation Program: Progress and Accomplishments—A Report to Congress*, Report No. 540/5-88/001, U.S. EPA, Washington, DC, February 1988.

Ronald D. Hill is the Director of the Superfund Technology Demonstration Division at the Risk Reduction Engineering Laboratory of the U.S. Environmental Protection Agency, Cincinnati, OH 45268. Robert A. Olexsey is the Chief of the SITE Demonstration and Evaluation Branch of the Superfund Technology Demonstration Division.

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